The hammerhead is viviparous, as many as 37 embryos having been taken from an 11-foot fish. Along the Atlantic coast fish 2 to 6 feet long are not uncommon, while larger examples are reported occasionally. The largest hammerhead of which we find record was 17 feet long, harpooned off Miami, Fla., on March 21, 1919.

Habitat.—Tropical and temperate seas; on both coasts of America from Cape Cod, Mass., and California southward.

Chesapeake localities.—(*a*) Previous record: Miles River, Md. (*b*) Specimens observed on present investigation: Lynnhaven Roads, Va., July, 1916, and June, 1921.

9. Sphyrna tiburo (Linnæus). Shovel-nose shark; Bonnet-nose shark.

Squalus tiburo Linnæus, Syst. Nat., ed. X, 1758, 234; America.
Sphyrna tiburo Jordan and Evermann, 1896-1900, p. 44, Pl. V, fig. 19.

Body moderately slender, compressed; head much depressed, expanded, the anterior margin semicircular, the posterior margins short, free, slightly concave, its greatest width quite equal to its length to first gill opening; eye small, lateral, 4 in preoral length of snout, nictitating membrane present; mouth moderate, its width 1.05 in preoral part of snout; teeth in jaws similar, with broad basal shoulders and a sharp, smooth cusp, the lateral teeth with a notch behind the cusp, upper jaw with about 30 teeth in a series, the lower with about 27; longest gill slit 2.1 in preoral part of snout; dermal denticles slightly imbricate, 3 and 5 keeled, the median keels projecting as sharp lobes; first dorsal rather short and high, elevated anteriorly, its origin slightly behind base of pectorals, the base 2.96 in distance between dorsals; second dorsal small, its posterior lobe elongate, pointed, the base 5.5 in distance between dorsals; upper lobe of caudal long, pointed, 35 in total length; anal fin notably longer than second dorsal and beginning farther forward, its base 1.05 in distance from anal to base of lower lobe of caudal; ventral fins moderate, inserted about equidistant from the origin of the first and second dorsals; pectoral fins rather small, 7.1 in total length.

Color grayish above, pale below.

This shark is represented in our collection by one small male specimen, 662 millimeters (26 inches) in length.

The food, as determined from specimens taken at Beaufort, N. C., consists of fish, crabs, shrimp, and other crustaceans.

This shark is viviparous, and as many as eight or nine young have been found at one time. (Smith, 1907, p. 35; Radcliffe, 1916, p. 266.)

This fish is comparatively rare in Chesapeake Bay, where only one specimen was observed. In the lower bay, between Ocean View and Cape Henry, however, fishermen said that it was occasionally taken in pound nets and they knew it well enough to give it the name "shovel-nose shark."

The maximum length attained is given as about 5 feet.

Habitat.—Tropical and temperate seas (Garman, 1913, p. 161); northward on the Atlantic coast of America to Long Island.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimen in collection: Lynnhaven Roads, Va., pound net, June 9, 1921.

Order TECTOSPONDYLI

Family VII.—SQUALIDÆ. The dogfishes

Body elongate; head depressed; eyes lateral, no nictitating membrane; nostrils inferior, separate, remote from the mouth; mouth rather large, inferior, with labial folds and a deep groove at each angle; spiracles present; gill slits 5, all in front of pectoral; dorsal fins 2, each preceded by a spine; no anal fin.

9. Genus SQUALUS Linnæus

Body rather slender; head flattened below; snout produced, tapering; nostrils transverse, inferior, remote from mouth; spiracles behind eyes; mouth wide, little arched, with a deep groove and with labial folds at each angle; teeth compressed, alike in both jaws, with oblique cusps; dorsal spines not grooved on sides; first dorsal near the pectorals; second dorsal behind ventrals; caudal pits present; lower lobe of caudal produced.

10. Squalus acanthias Linnæus. Spiny dogfish; Spiked dogfish; Grayfish.

Squalus acanthias Linnæus, Syst. Nat., ed. X, 1758, 233; coast of Europe.
Squalus americanus Uhler and Lugger, 1876, ed. I, p. 194; ed. II, p. 163.
Squalus acanthias Jordan and Evermann, 1896–1900, p. 54, Pl. VII, figs. 24 and 24a.

Body moderately slender, somewhat depressed anteriorly; caudal peduncle laterally with a low dermal fold; head low; snout pointed, 2.5 to 2.8 in head to first gill slit; its preoral part 1.75 to 2.1 in head; mouth moderate, its width at angles 2.55 to 3 in head; eye lateral, elongate, 2.15 to 2.25 in snout; interorbital space 2.3 to 2.8 in snout; teeth similar in each jaw, the cutting edges transverse, each tooth with a sharply pointed cusp, outer series in upper jaw with about 27 teeth, the lower jaw with approximately 22; longest gill slit 3.2 to 3.6 in snout; spiracles behind eyes, prominent; dermal denticles not imbricate, situated in more or less definite rows, each with a quadrangular base and a high median keel ending in a triangular apex; first dorsal rather small, preceded by a spine, the outer margin very slightly concave, its base 3.4 to 4.35 in space between dorsal fins; second dorsal smaller, with a larger spine, its base 4.4 to 5.6 in space between dorsal fins; upper lobe of caudal produced, no notch in lower margin, 4.6 to 5.35 in total length; ventrals inserted about equidistant from axil of pectoral and base of lower lobe of caudal; pectoral fins moderate, the posterior margin notably concave, 6.2 to 7 in total length.

Color grayish above (occasionally brown), pale below, sides with small, roundish, pale spots in one or several rows, most prominent in young up to 14 inches, almost disappearing in largest fish.

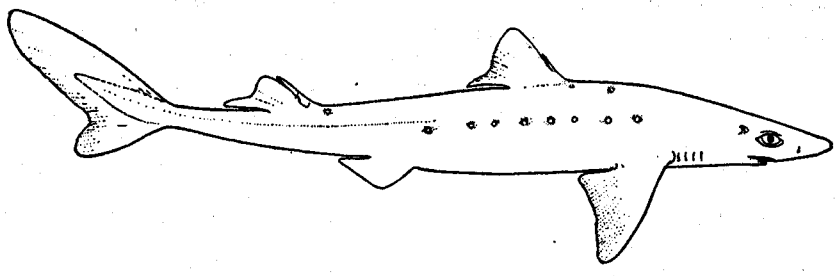

FIG. 29.—*Squalus acanthias*. (After Garman)

This shark is represented in our collection by six specimens—three males and three females—ranging in length from 560 to 800 millimeters (22 to 31½ inches).

The spiny dogfish is a very voracious feeder. The stomach of one contained a partly digested squeteague, probably *Cynoscion regalis*, approximately 7 inches in length, and that of another contained a mass of partly digested fish, from which eight menhaden, ranging from 3 to 5 inches in length, were recognizable. The other specimens, having been taken in pound nets, were not examined. One of several fish examined in the field by us had eaten crabs and a small croaker (Micropogon). Bigelow and Welsh (1925, p. 49) give the food of the spiny dogfish as all fish smaller than themselves, squid, worms, shrimps, prawns, crabs, and at times even ctenophores.

This shark is ovoviviparous. The large eggs, abundantly supplied with yolk, are at first in a horny capsule in the oviduct. Later the embryos break free, remaining in the oviduct or "uterus," with which they have no placental attachment. The period of gestation has been variously estimated, but it appears that 10 to 11 months, based upon the studies of Ford (1921, pp. 468–505), is correct.[3] Ordinarily, a female gives birth to three or four young at one time, but the number may be only one or as many as eight to eleven. Gudger (1912, p. 143) records a specimen at Beaufort from which three young were obtained. This fish was taken on May 23, but the size of the embryos was not given. Nichols and Murphy (1916, p. 32) state that spiny dogfish taken along the continental shelf off New York in late November contained well-developed young, the common number observed being three. They record a female taken near Gardiner's Island, N. Y., June 12, 1911, which gave birth to several young on the deck of the boat. We examined 12 specimens taken at Lynnhaven Roads, Va., April 4 to 8, 1922. Although selected at random, eleven were females and one was a male. The smallest fish (26 inches long) was the male. The length of the females and the number of embryos they contained are as follows:

[3] For an account of the embryology see Bigelow and Welsh, 1925, pp. 49–50.

Length, inches	Embryos or eggs	Length, inches	Embryos or eggs
28½	Immature eggs.	33¾	4 embryos.
31	2 embryos.	Do	1 large egg.
31½	Do.	34¼	4 embryos.
Do	1 embryo.	35¼	Do.
32	2 embryos.	35⅝	5 embryos.
32¼	4 embryos.		

This table agrees with the examinations of other investigators in that the number of young produced at one time usually is not more than four. It also suggests that larger fish produce more young than smaller fish, a fact noted also by Ford (1921, p. 473). The size of most of these embryos was 6 to 7 inches. At the time of birth dogfish are from 9 to 12 inches in length. Young appear to be born in the spring and autumn. If the period of gestation is 10 to 11 months, as probably is the case, a female can not give birth to young both in the spring and in the fall.

The spiny dogfish is generally common in the lower part of Chesapeake Bay, below the Potomac River, during the late fall and early spring. Nothing is known of its presence there in the winter, as fishing in the lower bay ceases entirely during this period. It is probable, however, that, due to the depleted food supply and the low water temperatures, it is scarce if not entirely absent during the winter. During the summer, at least from late May to October, it is entirely absent. Dogfish travel in schools, often appearing suddenly and irregularly. A set of two pound nets in Lynnhaven Roads, Va., caught spiny dogfish beginning with the first day's fishing—March 6, 1922. A few (perhaps less than 10) were taken nearly every day throughout the month. On April 4, when we began field operations in this locality, 25 were caught, followed by 8 on April 6 and 6 on April 8, all 2½ to 3 feet in length. It was of interest to note that all of these were taken by the pound net set in 32 feet of water, whereas the other net, placed in 12 feet of water and leading inshore directly from the deep-water net, caught none. On May 25, when these nets were again visited, no spiny dogfish were caught, nor had any been taken since early in May. At Cape Charles, Va., the fishermen reported this shark common in March and April. In the fall the spiny dog appears in apparently smaller numbers than in the spring. Our earliest record is November 15, 1922, when a 28½-inch fish was caught off Willoughby Spit, Va. Only stragglers are taken in pound nets late in November, or at the time when fishing ceases for the winter. Inquiries among the fishermen along the lower Potomac revealed that the spiny dogfish is not taken there, hence we can state with assurance that it is restricted to the lower parts of the bay, being most abundant near the capes.

Spiny dogfish are exceedingly abundant off the New England coast, at least from Nantucket Shoals to Cape Sable, Nova Scotia. They are present in this region from May until late October, or during the time when they are absent from Chesapeake Bay and points farther south. Along the New Jersey coast and western Long Island they appear suddenly in great numbers early in November, and are then regarded by fishermen as the forerunners of the cod. They soon disappear, however, and are not seen again until late April and early May, when they are present only a few weeks. Little appears to be known concerning the winter home of this dogfish. Their appearance south of New England directly after they leave and before they return would indicate a coastwise movement. Although they may occur as far south as the Carolinas, and to a more limited extent farther south, evidence produced by Bigelow and Welsh (1925, p. 47) indicates that the predominating migration is on and off shore rather than alongshore.

Spiny dogfish are usually from 2 to 3 feet long and attain a length of at least 3½ and possibly 4 feet. Females average somewhat heavier than males.

This shark is of no commercial importance in Chesapeake Bay and does not occur there in sufficient numbers to be regarded as a serious pest by the fishermen. Wherever abundant, it is destructive to other fish and fishing gear; because of this and its strong dorsal spines, with which it can inflict painful wounds, it is considered obnoxious by all fishermen.

Habitat.—On both coasts of the Atlantic; on the American Continents from Labrador to Uruguay, occasionally straying northward to Greenland.

Chesapeake localities.—(*a*) Previous record: Mouth of Chesapeake Bay. (*b*) Specimens in collection: Old Point Comfort, Va., beam trawl, depth 73 to 84 feet, December 2, 1915, April 2, 1921; Lynnhaven Roads, pound net, April 6, 1922, November 28, 1921; Willoughby Spit, Va., November 15, 1922; also seen at several other points in the southern sections of the bay.

Family VIII.—SQUATINIDÆ. The angel sharks

Body, head, and tail depressed and flat; snout obtuse; gill openings wide, partly inferior and partly hidden by the base of the pectorals; spiracles wide, crescent-shaped, behind the eyes; nostrils on the front margin of the snout, with skinny flaps; mouth terminal or nearly so; teeth rather small, far apart, erect; dorsal fins 2, small, subequal, situated on tail behind ventrals; anal fin wanting; pectoral fins very large, expanded in the plane of the body, but not attached to the side of the head, deeply notched at the base; ventral fins very large; caudal fin small.

This family of peculiar sharks is intermediate in both structure and general appearance between the sharks and rays.

10. Genus SQUATINA Duméril. Angel fishes

The characters of the genus are included in the family description. A single species is indigenous to the Atlantic coast of America.

11. Squatina dumeril Le Sueur. Nurse fish; Angelfish; Monkfish; Sand devil.

Squatina dumeril Le Sueur, Journ., Ac. Nat. Sci., Phil., I, 1818, p. 225, Pl. X; probably Florida.
Squatina squatina Jordan and Evermann (in part), 1896-1900, p. 58.

Body depressed throughout; head low, flat, its length to first gill slit 4.9 in total length; snout short and broad, the anterior outline slightly concave, 5.65 in head; eye small, 11.7 in head; spiracles crescent-shaped, at least as long as eye, situated behind eyes at a distance not quite equal to length of snout; interorbital very broad, concave, 2.4 in head; nostrils on anterior margin of snout, with skinny flaps, the interspace 3.5 in head; mouth only slightly behind anterior margin of snout, very broad, its width 1.5 in head; teeth, 18 in a series in each jaw, rather small, far apart, erect, with broad basal shoulders and a sharp median cusp; skin rough, with enlarged tubercles on head and snout and with sharp spines on outer margin of the pectoral fins; dermal dentacles in irregular rows rather far apart, of unequal size, each consisting of a low, strong, angled spine with a very broad base and a rather sharp point; gill slits 5, wide, all posterior to anterior angle of pectoral; pectorals broad, expanded, the anterior angle free from the body and not confluent with the head, the length of the outer anterior margin of fin 3.4 in total length, the outer posterior angle a right angle, the inner lobe of fin round; dorsal fins of about equal size, situated on the tail, far behind ventrals, the base of first dorsal 1.45 in distance between dorsals, the base of the second 1.55; caudal fin posteriorly truncate, both lobes pointed, the lower slightly the longer, 1.55 in head; ventral fins inserted opposite posterior margin of pectorals, very broad (the claspers in the male specimen at hand—that is, 42½ inches long—are 7½ inches in length).

Color grayish above, pale below. The abdomen, throat, and ventral fins with reddish spots in life.

A single male specimen, 1,080 millimeters (42½ inches) in length, occurs in the Chesapeake Bay collection. This peculiar fish, which has the combined characters of a shark and a ray, is a conspicuous form. Years ago it was said to be rather common on the Atlantic coast of Maryland. Within Chesapeake Bay, certainly, it is very rare, and none at all were seen or reported during the intensive collecting of 1921 and 1922. Lugger (1878, p. 122) says of this animal: "The not very inviting looks of this fish are not the only reasons why fishermen dislike it. It has, to some extent, the unpleasant habits of the snapping turtle, since it can open its mouth very suddenly, to an alarming extent, and not to play, either. In consequence of this biting propensity, it is called by the fishermen the 'sand devil,' and also the 'fair maid'; the first name not without any reason and the latter certainly not out of politeness."

Habitat.—Both sides of the Atlantic and on our Pacific shores, occurring sparingly northward on our Atlantic coast to Cape Cod, Mass.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimen in collection from Lynnhaven Roads, Va., pound net, July 15, 1916.

FIG. 30.—*Squatina dumeril.* From a specimen 42.5 inches long

Order BATOIDEI. The skates and rays

Family IX.—PRISTIDÆ. The sawfishes

Body elongate, depressed; snout produced into a long, thin, flat process, armed laterally with a series of large, strong teeth; teeth in the jaws numerous, small, in pavement; gill slits moderate, inferior; spiracles wide, placed behind the eye; eyes without nictitating membrane; dorsal fins 2, large, the first nearly opposite ventrals; caudal fin well developed, bent upward; a fold along each side of tail; pectoral fins moderate, their front margins not extending to the head. A single genus is known. Viviparous.

11. Genus PRISTIS Linck. Sawfishes

The characters of the genus are included in the family description. A single species is known from the waters of the Atlantic coast of the United States. The sawfishes are bottom-dwelling animals. The large, sawlike rostrum probably is not used extensively as an offensive weapon, but it forms an effective defensive weapon, as the fish can strike from side to side with great force.

12. Pristis pectinatus Latham. Sawfish.

Pristis pectinatus Latham, Trans., Linn. Soc., London, II, 1794, p. 278, Pl. XXVI, fig. 2; "in the ocean." Jordan and Evermann, 1896-1900, p. 60, Pl. VIII, fig. 27; Garman, 1913, p. 262.

Pristis antiquorum Uhler and Lugger, 1876, ed. I, p. 190; ed. II, p. 160.

Body depressed, its depth between the dorsals about equal to its width at the same point; caudal peduncle depressed, provided with a lateral keel on each side; rostrum (or "saw") of moderate width, tapering, provided with 24 to 32 strong teeth on each edge, varying with age and among individuals; teeth on the jaws in pavement, in many rows; origin of first dorsal opposite or a little posterior to the origin of the ventrals; second dorsal scarcely smaller than the first; the lower lobe of caudal not produced; pectoral fins broad, the outer angles blunt, posterior margins nearly straight.

Color, dark gray or brownish above, pale yellow or white below.

The sawfish was not seen during the present investigation, but it was reliably reported by pound-net fishermen operating in the lower parts of Chesapeake Bay. The foregoing description was compiled from published accounts.

The prolongation of the snout, with its armature of teeth, at once identifies the sawfish from all other Atlantic fishes. Six species are known to exist. The only other species (*P. microdon*) found on this side of the Atlantic, chiefly in the Tropics, has 17 to 23 teeth along its snout, whereas the present species has 24 to 32 teeth. The number of teeth on each side of the snout may or may not be the same. A 14-foot fish taken by us at Key West had 28 teeth on the left and 27 teeth on the right side. Three 30-inch fish taken by us at Marco, Fla., had the following counts of rostral teeth: 24–24, 24–25, 25–25. The last-mentioned young fish were taken in the same locality on the same day. They were found swimming slowly along, parallel to and within 3 or 4 feet of the shore. Each was thrown ashore with a dip net. As they were exactly the same length (30 inches), it is quite certain that they were of the same age, and it is likely that they were recently born. This species gives birth to live young, as many as 20 being produced at one time. It is said to deliver its young in the summer, but as the three newly born fish mentioned above were found early in January, it is probable that young are born over an extended period, the period of reproduction varying in different sections with the climate.

The sawfish is only an occasional visitor in the lower Chesapeake.

Pound-net fishermen at Ocean View and Lynnhaven Roads report that it is rarely taken—sometimes one or two fish a year and sometimes none. The capture of a sawfish is long remembered by the fishermen, for it is very destructive of nets, from which it is removed with great difficulty.

This sawfish is said to attain a length of 20 feet. Examples 10 to 16 feet in length are not rare.

Habitat.—Caribbean Sea, Gulf of Mexico, and the east coast of the United States as far north as New Jersey.

Chesapeake localities.—(*a*) Previous record: "Occasionally enters Chesapeake Bay." (Uhler and Lugger, 1876.) (*b*) Specimens in collection: None. The species was not seen during the present investigation, but it was reliably reported by fishermen operating pound nets in the southern parts of the bay.

Family X.—RAJIDÆ. The skates

Body and head much depressed, united with the pectorals and forming a rhomboid disk; tail distinct, stout, rather long, with lateral folds; dorsal fins 2, small, both on the posterior half of the tail; eyes and spiracles superior; mouth inferior, small; teeth small, numerous, in pavement; skin usually more or less rough, with small spines and larger tubercles. The species are oviparous, the eggs being laid in large, leathery, four-angled cases, with two tubular "horns" at each end.

12. Genus RAJA Linnæus. Skates

Disk subquadrangular or subcircular; snout more or less produced, pointed, supported by a "rostral cartilage"; spiracles present, close to eyes; teeth small, varying from flat to sharp and pointed; pectoral fins not confluent around the snout; ventral fins deeply notched; dorsal fins 2; tail with a membranous fold on each side.

KEY TO THE SPECIES

a. Snout very blunt, only the tip projecting beyond the general outline of the disk; median line of back and tail without a row of enlarged spines; tail with three lateral rows of spines on each side; teeth in about 74 series in each jaw ..... *diaphanes*, p. 56

aa. Snout acute; median line of back and tail with a series of enlarged spines; tail with a single lateral row of enlarged spines on each side; teeth in fewer than 50 series in each jaw.

b. Dorsal surface mostly beset with bony prickles; snout only moderately acute; teeth in about 48 series in each jaw; dark markings on dorsal surface mostly elongate .. *eglanteria*, p. 58

bb. Dorsal surface largely smooth; snout very acute; teeth in 32 to 36 series in each jaw; dark markings on dorsal surface roundish ..... *stabuliforis*, p. 59

aaa. Snout moderate, more pointed than in *diaphanes* but less so than in *eglanteria* and *stabuliforis*; median line of back nearly or quite without tubercles; tail with two to four lateral rows of enlarged spines; teeth in about 50 series in each jaw ..... *erinacea*, p. 60

13. Raja diaphanes Mitchill. Common skate; Spotted skate.

Raja diaphanes Mitchill, Trans., Lit. and Philo. Soc., N. Y., I, 1814, p. 478; New York. Garman, 1913, p. 339, pl. 22, fig. 1.
Raja ocellata Jordan and Evermann, 1896–1900, p. 68, Pl. X, fig. 30.

Disk broader than long, the anterolateral margin double concave, a slight concavity opposite snout and a very broad one opposite eyes and spiracles, the posterolateral margin broadly and evenly convex, length of disk 1.15 to 1.25 in its width, the width of disk 1.45 to 1.6 in total length; head to first gill slit 2.95 in width of disk; distance from snout to vent, 1.25; tip of snout projecting beyond the general outline of the disk, the length of snout 4.5 to 5.35 in width of disk; preoral length of snout 1.75 in head; interorbital (bone) 1.8 to 2.4 in snout; eye 5.55; spiracles immediately back of eyes, the longest diameter somewhat greater than the length of eye; nasoral groove extending to mouth; teeth in about 74 series in each jaw, each tooth with a roundish base, surmounted by a very low, blunt cusp, at least in the posterior, or newer, series; skin in the female on upper surface largely beset with prickles and spines; median part of head naked, also the snout, except the tip, which bears enlarged spines; the anterolateral margin of disk with a band of enlarged spines continued as intramarginal spines posteriorly; no definite spines or tubercles on median line of back or tail; three lateral rows of spines on each side, beginning on middle of back and extending backward on the tail, becoming larger posteriorly; the upper surface in the male somewhat less prickly, but with the spines on the margins of the disk larger; tail moderate, depressed, with dermal keel along lower ventral edges, 2.1 in total length; dorsal fins 2, close together; caudal fin represented by a dermal fold; ventral fins long, inserted somewhat in advance of posterior margin of disk, greatly thickened at the base, the fins rather deeply notched.

Color of upper parts brown, light brown, or grayish-brown, everywhere covered with irregular dark spots, variable in intensity; a white ocellated spot on pectoral somewhat in advance of its inner posterior angle. (This spot, according to Garman (1913, p. 339), may be present or absent.) White underneath.

This species is readily distinguished from the "clear-nose skate," *Raja eglanteria*, its nearest relative of the genus in Chesapeake Bay, by the shorter and less strongly pointed snout, the more numerous and larger prickles, and especially by the absence in the present species of an enlarged series of spines on the median line of the back and tail. The color, too, presents noticeable differences, the pair of white ocellated spots on the pectorals of *R. diaphanes*, when present, being very evident.

This skate feeds chiefly on rock crabs and squid. (Bigelow and Welsh, 1925, p. 61.) They take, also, small crustaceans, razor clams, and such fish as they can capture.

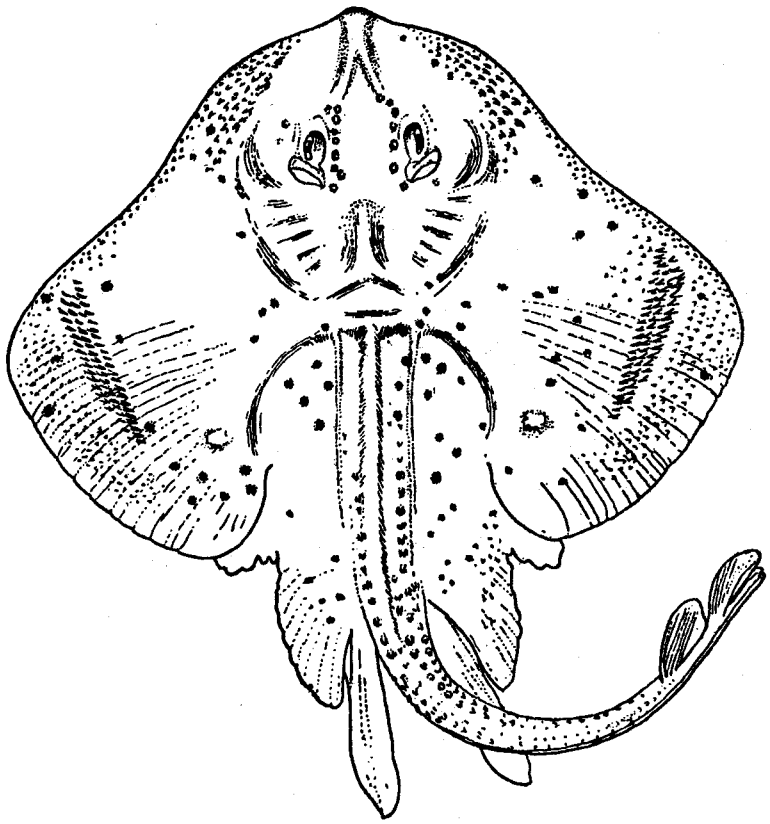

FIG. 31.—*Raja diaphanes*, male. (After Garman)

The breeding habits of this skate are unknown, except that, like all members of this family, the eggs are laid in leathery pouches.

A single specimen was preserved, but many were examined in the field, upon which notes and measurements were based, and these have been used in the foregoing description. The specimens examined ranged in length from 29 to 36 inches and the width of the disk varied from 19 to 25 inches. This skate was seen only in the southern parts of the bay, where it enters pound nets. Twelve to twenty-two individuals were taken each day in two pound nets located in Lynnhaven Roads, Va., from April 4 to 8, 1922, when the daily catches were observed; and one specimen was taken by the *Fish Hawk* near Cape Henry on January 16, 1914. This skate was not seen elsewhere in the bay, nor was it seen in the southern part of the bay on other dates than those pre-

viously mentioned, although observations of commercial catches and collections were made at nearly all seasons of the year. This species is recognized by the fishermen as distinct from the "clear-nose skate," but they do not appear to have a distinctive name for it, referring to it only as "skate." According to the local fishermen, this skate is taken only in the spring, when pound-net fishing is first resumed for the season, and at this time it is taken in considerable numbers.

The maximum length is about 6 feet.

Habitat.—Atlantic coast, from Virginia northward to Gulf of St. Lawrence.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimen in present collection: Lynnhaven Roads, Va., pound net, April 4, 1922. Many others were observed during April at Lynnhaven Roads and also were taken near Cape Henry during January.

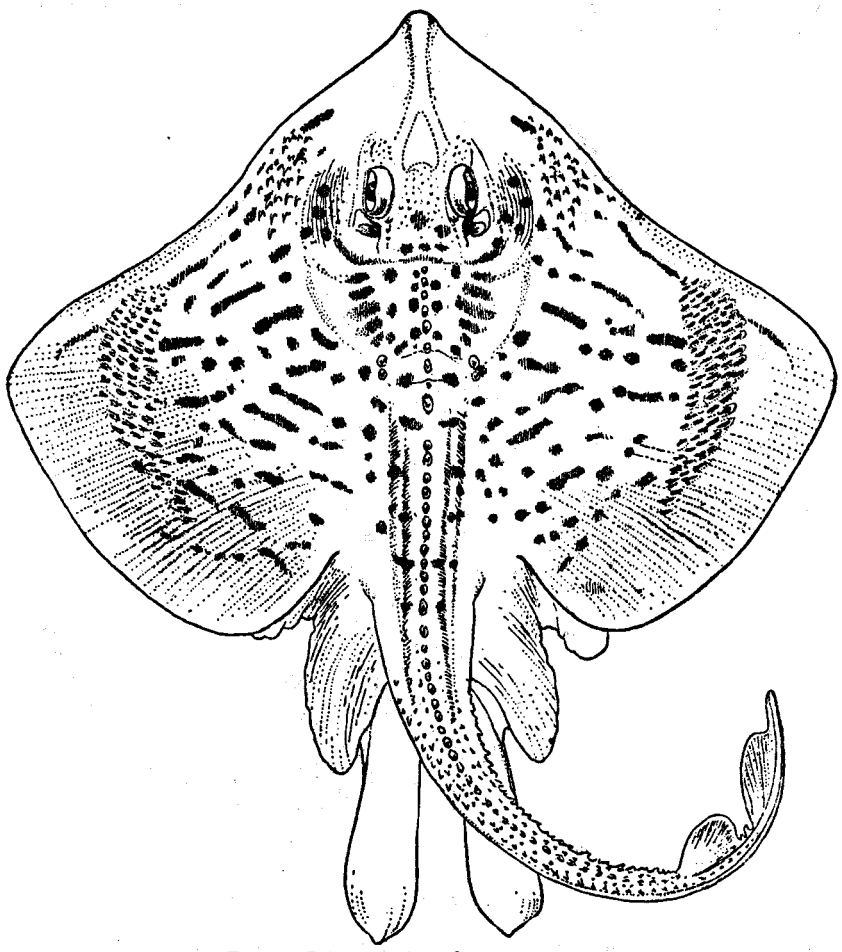

FIG. 32.—*Raja eglanteria*, male. (After Garman)

14. Raja eglanteria Lacépède. Clear-nose ray; Brier ray.

Raia eglanteria Lacépède, Hist. Nat. Poiss., II, 1800, p. 109, Pl. IV, fig. 2; Charleston, S. C. Garman, 1913, p. 341, pl. 23.
Raja eglanteria Uhler and Lugger, 1876, ed. 1, p. 188, ed. 2, p. 159; Jordan and Evermann, 1896-1900, p. 71.
? *Raia lævis* Bean, 1891, p. 94.

Disk broader than long, anterolateral margins double concave, a slight concavity opposite snout and a much larger and broader one behind eyes, the margins meeting anteriorly in an angle a little greater than 90°, the outer angles rounded, the posterolateral margins broadly and evenly convex, length of disk 1.2 to 1.3 in the width; head to first gill slit 2.7 to 3.5 in width of disk; dis-

tance from snout to vent 1.15 to 1.37; snout projecting, apparently longer in females than in males, supported by a rather narrow cartilage with a large translucent area on each side, its length 1.45 to 1.57 in head; preoral length of snout 1.4 to 1.8; width of mouth 2.5 to 2.8; interorbital (bone) 4.8 to 5.25; eye 4.7 to 5.2 in snout; spiracles immediately behind eyes, slightly crescent-shaped, about as long as eyes; nasoral groove extending to mouth; teeth in about 48 rows in each jaw, each tooth with a large round or oval base, surmounted by a small pointed cusp on the posterior or newer teeth, the anterior or older teeth smooth, without pointed cusps; skin above largely beset with small bony prickles, these somewhat enlarged on tip of snout; a row of short, heavy spines on inner margins of eyes and spiracles; a few enlarged tubercles opposite median line of back on shoulders; a row of short, sharp spines on median line of back, extending from behind head to origin of first dorsal fin; tail with a row of enlarged spines on each side and with other prickles larger than those on the body; the male somewhat smoother than the female, with a patch of small recurved spines on disk opposite eyes and another intramarginal patch at widest part of disk; tail moderate, the base depressed, its length 1.9 to 2.25 in total length; dorsal fins 2, placed near the extremity of the tail, less than eye's diameter apart in four specimens examined, an eye's diameter in one specimen, and confluent in another; caudal fin represented by a dermal fold extending around the end of the tail; ventral fins long, beginning only a little in advance of the margin of the disk, greatly thickened at the base anteriorly, the fin deeply notched; the claspers in the male rather broad, not projecting far beyond posterior margins of the ventrals in adults.

Color varying from brownish to grayish above, with roundish and elongate dark markings on disk posterior to snout; lower surface white.

The foregoing description is based upon six preserved specimens—two males and four females—ranging in length from 457 to 672 millimeters (18 to 26½ inches); others were examined in the field. This ray is called "clear-nose" in allusion to the translucent snout and "brier ray" because of the numerous spines and prickles that beset the upper surface of the body and tail. This species, the sting ray (*Daybatus say*), and the sand skate (*Pteroplatea macrura*) are about equally common in the southern part of Chesapeake Bay. Early in April, in a set of two pound nets in Lynnhaven Roads, 7 to 15 brier rays were caught daily; and on May 25, when we again visited these nets, the catch was 25, all 1½ to 2½ feet in length.

This ray was found to feed chiefly on crustaceans and fish. Two stomachs examined in April contained crabs, shrimp, and fish; two examined in May contained shrimp and fish, and three in October the following: One had eaten a blue crab (Callinectes) 1 inch long; another a lizard fish (Synodus) 8 inches long; and the stomach of the third contained several blue crabs, 1 to 1½ inches long. The structure of the teeth suggests that mollusks and crustaceans probably form the principal foods.

Habitat.—Cape Cod to Florida; rarely to Cape Ann, Mass.

Chesapeake localities.—(*a*) Previous records: "Around the mouth of Chesapeake Bay" (Uhler and Lugger, 1876); Cape Charles City, Va. (*b*) Specimens in collection: Lynnhaven Roads, Va., pound nets, June 9, 1916, May 20 and September 27, 1921, and May 25, 1922. Numerous individuals also were seen and examined at Ocean View, Va., during the fall of 1922. It also was taken at 11 *Fish Hawk* stations, all made in southern sections of the bay during 1915 and 1916.

15. Raja stabuliforis Garman. Barn-door skate; Smooth skate.

Raja lævis Mitchill, Amer. Monthly Mag., II, 1818, p. 327; New York, not of Gronow. Jordan and Evermann, 1896-1900, p. 71; Uhler and Lugger, 1876, ed. I, p. 189; ed. II, p. 160.

Raia stabuliforis Garman, 1913, p. 341, pl. 22, fig. 2; pl. 44, figs. 4 to 6.

Disk broader than long, its width 1.5 in total length of fish, the length of disk 1.25 in its width; anterolateral margins slightly double concave; posterolateral margin broadly rounded; snout strongly projecting, acute; eyes small; spiracles as large as eyes; mouth large, the width more than half the length of the snout; teeth quite blunt in the female, sharper in males, in about 32 to 36 series in each jaw; upper surface comparatively smooth; tip of snout with small tubercles, and a narrow band of similar tubercles along anterolateral margin; small tubercles over the eyes and spiracle; a median row of compressed spines beginning on back and extending on tail; a similar row on each side of tail. The male, in addition to the armature already described, has a triangular patch of large sharp spines on disk opposite eyes, a large area of similar spines situated opposite the outer angle of the disk at about the beginning of the outer third of the disk.

Color of a fresh male specimen, 49 inches long, brownish above, with many scattered small dark spots of unequal size, the largest equal to the size of the eye; a pair of large, irregular, prominent, ocellated spots on the disk opposite the outer angles of pectorals; ventral surface nearly plain. The ocellated spots on the disk in the specimen described are sometimes wanting, and the lower surface is frequently marked, particularly in large individuals, with dusky or gray. The color of a female 46 inches long, taken with the above male, differed in having fewer spots and in the smaller size of the ocellated spots.

This species is readily recognized by the long, acute snout, by the smoothness of the skin on the upper surface, the prickles being much fewer than in related species, and, usually, by its large size.

The specimens of this species were too large to preserve conveniently. The above description is based upon several large specimens examined in the field and also upon published accounts.

The barn-door skate, like most other skates, feeds mainly on the bottom. Its food (Bigelow and Welsh, 1925, p. 67) consists of mollusks, crustaceans, fish and worms. It is regarded as more destructive of fish than any of the other skates.

The breeding habits of the barn-door skate are unknown.

The barn-door skate is frequently taken in early spring with pound nets in the southern part of Chesapeake Bay. The wings or "saddles," as they are called by the fishermen, are sometimes removed from the fish and shipped to New York, where there is a fair demand for them. In parts of Europe skate saddles are considered a delicacy, and it is the foreign population of New York and vicinity that furnishes most of the demand for them.

The barn-door skate reaches a length of 6 feet, and examples 4 to 5 feet long are not at all rare. The three largest seen by us in the Chesapeake were 46 to 49 inches in length.

Habitat.—Nova Scotia to Florida.

Chesapeake localities.—(*a*) Previous records: "Not uncommon in the ocean off Worcester County, but said to be scarce in Chesapeake Bay." (Uhler and Lugger, 1876, pp. 160 and 189.) (*b*) Specimens in present collection: None. A number of individuals, all large, were observed during the present investigation. They were taken in the spring with pound nets located at Ocean View and in Lynnhaven Roads, Va.

16. Raja erinacea Mitchill. Common skate; Little skate; Summer skate.

Raja erinaceus Mitchill, Amer. Journ. Sci. Arts, IX, 1825, p. 290; New York.
Raja erinacea Jordan and Evermann, 1896–1900 p. 68; Pl. IX, fig. 29; Garman, 1913, p. 337, pl. 20; pl. 55, fig. 5; pl. 68, fig. 1.

"Anterior margins of disk waved, convex opposite the eyes, concave opposite spiracles, outer and hinder angles and margins rounded. Snout short, longer than that of *R. diaphanes*, about one and one-half times the interspiracular width. Mouth strongly waved; teeth in about 50 rows. Back rough with strong, hooked spines over almost the entire surface on females, especially rough near and on head, on the snout, about the shoulders, on the hinder portions of the pectorals, and on the tail. A triangular patch of strong spines appears in front of the shoulder girdle; others are seen on each shoulder and in one to several rows at each side of the median line of the back. The ventral line is quite or nearly without tubercles; the tail has two to four rows on each side. Males have not so many tubercles as the females; their spines are more scattered, and smooth spaces exist on the middle of the back, over the gills, and above the abdomen; they have the band of erectile tenacula near the outer angle of the pectoral. * * *

"Back light grayish brown to very dark, clouded to uniform, usually spotted with small spots of darker, margins sometimes light. Color darker northward." (Garman, 1913.)

This species was not seen during the present investigation and it is not recorded from Chesapeake Bay. The species is included here on the authority of certain field notes by Dr. W. C. Kendall, made during an investigation in 1894, which he has kindly placed at our disposal. In these notes we find it stated that *R. erinacea* was taken in pound nets near Hampton, Va., on March 13 and 24 (one specimen on each date), and again near Cape Charles, Va., on March 21. Of the latter he says: "A few *R. erinacea* were brought in from the pounds."

"Little skates are omnivorous. Hermit and other crabs, shrimps, worms, amphipods, ascidians ('sea squirts'), bivalve mollusks, squid, small fishes, and even such tiny objects as copepods have been found in their stomachs." (Bigelow and Welsh, 1925, p. 59.)

Off the coast of southern New England, where the species is abundant, the eggs are taken from March to September, being most numerous during July and August. The egg, together with its case, is about 2 inches broad and 2½ inches long. The empty cases of these eggs frequently are seen washed upon the beach.

This is a common skate on our coast from Virginia northward. Its usual length ranges from 1 to 2 feet.

Range.—"Halifax to the Carolinas, abundant off New England and New York." (Garman, 1913.)

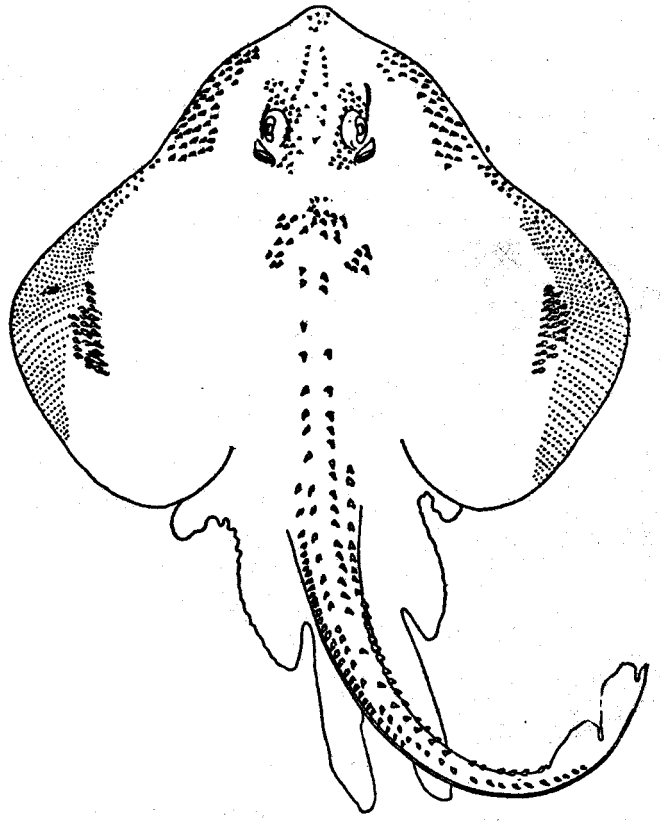

FIG. 33.—*Raja erinacea*, male. (After Garman)

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimens in the collection: None.

The present record is based upon field notes by Dr. W. C. Kendall made during March, 1894, in which the capture of this species in pound nets near Hampton and Cape Charles, Va., is reported.

Family XI.—TORPEDINIDÆ. The electric rays

Head, trunk, electric organs and pectorals forming a depressed subcircular disk; tail short, rather stout, with or without a lateral membranous fold; spiracles present; gill slits small, between the electric organs and the head; electric organs composed of vertical cells, situated between the pectoral fins and the head; nasal valves confluent, forming a quadrangular lobe; skin smooth, unarmed; dorsal fins 2, 1, or none; caudal fin not lobed.

13. Genus TORPEDO Duméril. Electric rays

Disk broader than long, subcircular; snout short, broad; tail short, distinct, with a large caudal fin and a low dermal keel on each side; spiracles moderate, placed at a short distance back of the eye, without fringes on the margins; mouth crescent-shaped, with a longitudinal fold on each side; dorsal fins 2; ventral fins separate and distinct. A single species is known from the Atlantic coast of the United States.

17. Torpedo nobiliana Bonaparte. Torpedo; Electric ray; Crampfish

Torpedo nobiliana Bonaparte, Fauna Ital., 1832, fasc. 12; Italy.
Torpedo occidentalis Uhler and Lugger, 1876, ed. I, p. 188; ed. II, p. 159.
Tetronarce occidentalis Jordan and Evermann, 1896–1900, p. 77, Pl. XI, fig. 33.
Narcacion nobilianus Garman, 1913, p. 310, pl. 25, fig. 2; pl. 61, figs. 4 and 5.

Disk broader than long, the sides broadly rounded, the anterior margin slightly concave; tail short, thick, depressed, tapering abruptly, with a dermal fold on each side; spiracles close behind the eyes, their edges not fringed; mouth large, crescent-shaped, with a groove at each angle; teeth small, broad-based, with acute crowns on inner edges; skin smooth and unarmed; first dorsal about twice as large as the second, its origin in advance of the posterior edges of ventrals; caudal fin large, its posterior margin slightly rounded to slightly concave posteriorly.

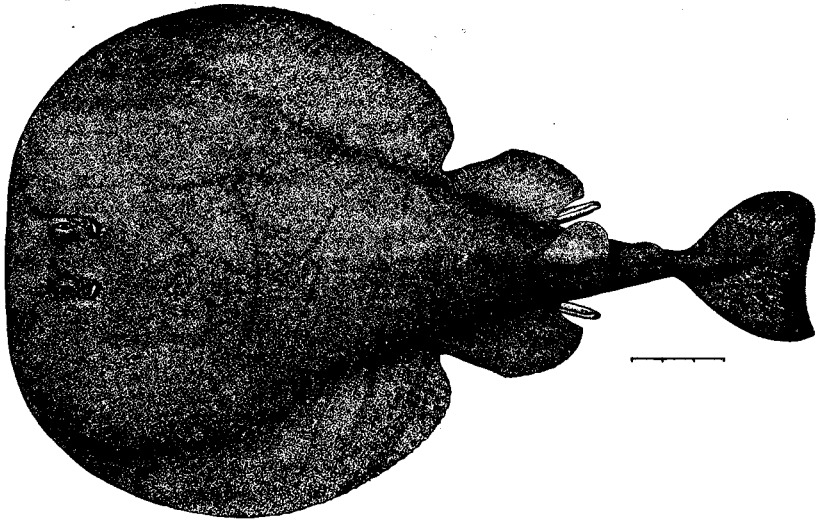

FIG. 34.—*Torpedo nobiliana*

Color above, uniform dark brown; mostly white underneath; the edges of the disk and the ventrals underneath purplish; caudal peduncle with irregular dark markings along ventral edges. Day (1880–1884, p. 331) records the color of European specimens as dull reddish gray or dull ash above, dashed with purple, and white below, sometimes with ill-defined blotches on the dorsal surface.

A single large (female) specimen, weighing about 100 pounds, was taken during the present investigation, upon which the following measurements are based:

	Inches
Total length	47.6
Width of disk	35.6
Length to base of first dorsal	31.1
Distance between dorsal fins	2.1
Interorbital (bone)	1.6
Space between spiracles	2.6
Length of base of first dorsal	3.1
Length of base of second dorsal	1.7
Height of first dorsal	3.9
Height of second dorsal	2.6
Greatest width of caudal fin	10.5

The species is rare in Chesapeake Bay, where it is occasionally caught in the most southern parts. The fishermen do not seem to have a distinctive name for the animal, as those who saw the specimen merely called it a "ray." The species is readily recognized by its smooth, soft skin, dark brown color, broad disk, which is straight or slightly concave in front of eyes, and by the large caudal fin.

The torpedo is said to reach a weight of 200 pounds, and a specimen as heavy as 170 pounds has been recorded from Massachusetts Bay (Bigelow and Welsh, 1925, p. 69). A specimen has been recorded from Cape Lookout, N. C., which was 60½ inches in length and weighed 125 pounds.

It has long been known that the torpedo is capable of emitting strong electric shocks from large electric organs situated on each side just back of the head, a shock from a large fish being sufficient to knock a man down.

Little is known of the feeding habits of this ray along our coast, but Day (1880–1884, p. 331), working with European specimens, records from the stomach of one fish a 2-pound eel and a 1-pound flounder and from another a 4 or 5 pound salmon, all of which, he believes, may have been killed by the electric organs of the fish.

The species is viviparous, but little is known of its breeding habits.

Habitat.—Tropical and temperate parts of the Atlantic Ocean, from Maine to Cuba on the American coast and from the coasts of Great Britain to Madeira, including the Mediterranean Sea, on the European coast.

Chesapeake localities.—(*a*) Previous records: "Said to occur very rarely in the region near the entrance of Chesapeake Bay." (Uhler and Lugger, 1876). (*b*) Specimens seen or preserved during the present investigation: One large female, about 4 feet long, taken in a pound net in Lynnhaven Roads, Va., on May 25, 1922.

Family XII.—DASYATIDÆ. The sting rays

Body, head, and pectorals depressed, together forming a broad disk; the pectorals very broad and united around the snout; no supporting cartilage in snout; tail distinct from the disk, either long or short, and usually bearing one or more strong, serrated spines; spiracles large and near the eyes; skin smooth, or rough and with spines or tubercles, or both. The species are viviparous or ovoviviparous. The family contains numerous genera and species. Only two genera are represented in the Chesapeake Bay fauna.

KEY TO THE GENERA

a. Tail long and slender, whiplike, bearing one or more strong, serrated spines; disk more or less quadrangular to circular, not much broader than long.....Dasyatis, p. 63

aa. Tail short, the spine present or absent; disk much broader than long.....Pteroplatea, p. 67

14. Genus DASYATIS Rafinesque. Sting rays

Disk more or less quadrangular to circular, very strongly depressed; snout more or less prominent; tail long, whiplike, with one or more strong, serrated spines, with or without dermal fin folds or keels on the median line above, below, and behind the caudal spines; without lateral folds on the base; skin usually more or less spiny in adults; teeth small, paved.

KEY TO THE SPECIES

a. Tail without a dermal fin fold above, a rather broad fold below, its length more than twice the length of the disk; disk broader than long, its length about 1.25 in its width.....*centrura*, p. 64

aa. Tail with a dermal keel or fin fold above and below, its length less than twice the length of the disk.

b. Tail with a low dermal keel above and a rather broad fold below; the color of the folds black; the disk quadrangular, its length about 1.2 in its width; middle of forehead with a small; round, light-colored spot.....*americana*, p. 64

bb. Tail with a dermal fold above and below, both of about equal size, color of folds black; the disk rather narrower than in *americana*, little broader than long, its length about 1.1 in its width, the outline of the disk meeting at snout at an angle of about 120°; no light-colored spot on middle of forehead ..... *say*, p. 66

bbb. Tail with a dermal fold above and below, the lower one the larger, the color of the folds brownish to yellowish, the lower one always of light color; disk still narrower, the length about equal to the width; snout more pointed than in related species, the outline of the disk meeting anteriorly at an angle of about 90°; no light-colored spot in the middle of the forehead ..... *sabina*, p. 67

18. Dasyatis centrura (Mitchill). Sting ray; Stingaree.

Raja centrura Mitchill, Trans., Lit. Philo. Soc., N. Y., I, 1815, p. 479; New York.
Trygon centrura Uhler and Lugger, 1876, ed. I, p. 187; ed. II, p. 158.
Dasyatis centrura Jordan and Evermann, 1896–1900, p. 83.
Dasybatus marinus Garman, 1913, p. 382, pl. 33, figs. 1 and 2.

Disk quadrangular, notably broader than long, its length about 1.25 in its width, antero-lateral margins concave opposite the eyes, convex toward the slightly protruding snout, the outer angles rounded, the postero-lateral margins little convex; mouth arched forward, with five papillæ at base of lower jaw; teeth blunt, arranged in pavement; tail more than twice the length of the disk, bearing one or more strong, serrated spines, with a broad winglike expansion below but none above; young smooth, adults with conically pointed, broad-based tubercles on the middle and hinder parts of the back and on the top and sides of the tail, very old examples with still more numerous spines and tubercles on the back. Color dark brown above, pale underneath.

This ray was not taken in Chesapeake Bay during the present investigation and no specimens are at hand. The above description was compiled from published accounts. This species may be distinguished from all the others of the Chesapeake region by the entire absence of a fin fold on the dorsal surface of the tail, posterior to the large, serrated spine or spines, and by the prominent expansion of the fold below the tail. The tail appears to be longer than in related species, equaling more than twice the length of the disk.

The food of this ray no doubt is similar to that of related species, as it has the same type of teeth, which are suitable for crushing hard objects, such as the shellfishes. This ray appears to reach a larger size than the related rays, a length of about 12 feet from snout to tip of tail having been reported.

This ray probably is rare in Chesapeake Bay. It is included here on the strength of the following statement by Uhler and Lugger (1876, p. 187): "Common on the coast of Worcester County and *around the entrance to Chesapeake Bay.*"

Habitat.—Atlantic Ocean and Mediterranean Sea (Garman, 1913). On the American coast from Cape Cod to Cape Hatteras.

Chesapeake localities.—(*a*) Previous records: Around the mouth of Chesapeake Bay (Uhler and Lugger, 1876). (*b*) Specimens in the present collection: None.

19. Dasyatis americana sp. nov. Sting ray; Stingaree.

Dasibatis hastata Garman, in Jordan and Gilbert, Bull. U. S.Nat. Mus., XVI, 1882 (1883), p. 70. Not of De Kay, which herein is understood to be equivalent to *D. centrura* (Mitchill), and which, in turn, as understood by Garman (1913, p. 382), is identical with *D. marinus* Klein.
Dasyatis hastata Jordan and Evermann, 1896–1900, p. 83. Not of De Kay.
Dasybatus hastatus Garman, 1913; p. 391. Not of De Kay
Type No. 88378, U. S. National Museum; length of disk 15 inches; type locality, Crisfield, Md.

This ray is very similar to *say*, from which it may be distinguished, however, by the absence of a broad, winglike expansion on the upper side of the tail, which is replaced by a low, black keel; the cutaneous folds below the tail are identical in the two species; the disk appears to be slightly shorter in proportion to its width, and the ventral fins apparently project a little farther beyond the disk. This species bears a small, round, light-colored spot on the middle of the forehead, which is wanting in *say*. The following proportions were obtained from a male specimen having a disk 15 inches in length; length of disk in its width 1.2; distance from snout to vent 1.35 in width of disk; head to first gill slit 3.7; snout 1.6 in head; preoral length of snout 1.48; interorbital (bone) 3.43; width of mouth 3.1; eye 3 in snout; tail 1.63 in total length.

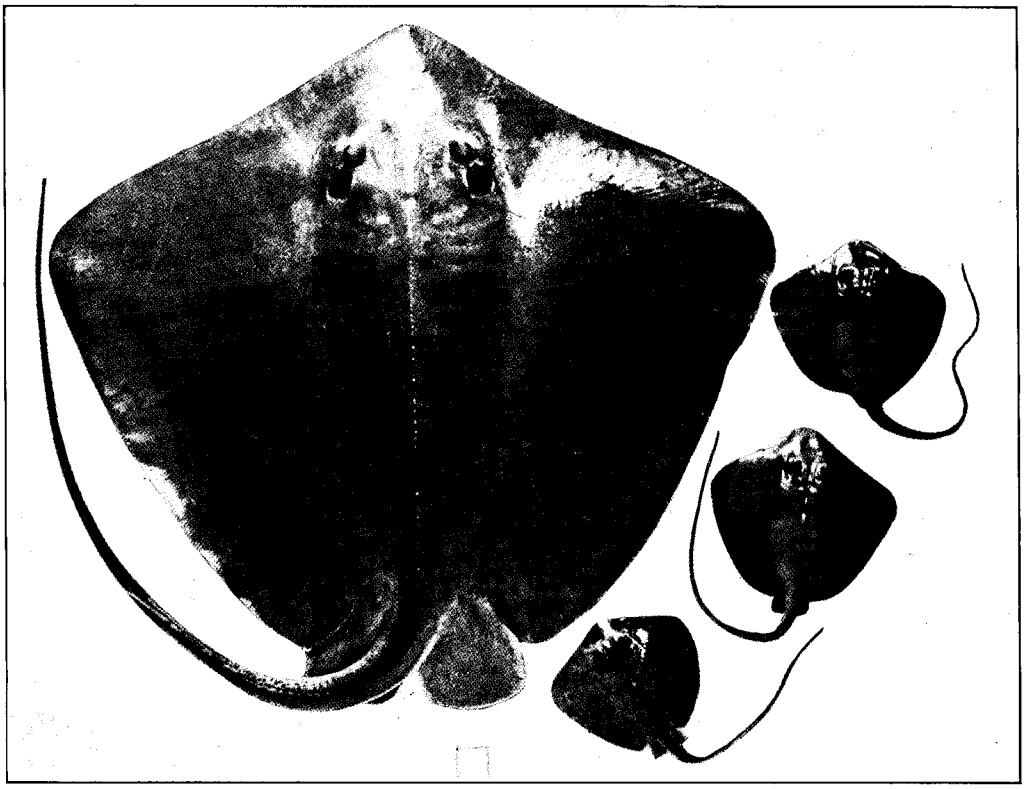

FIG. 35.—*Dasyatis americana* sp. nov. From a female 62 inches long, and newly born young

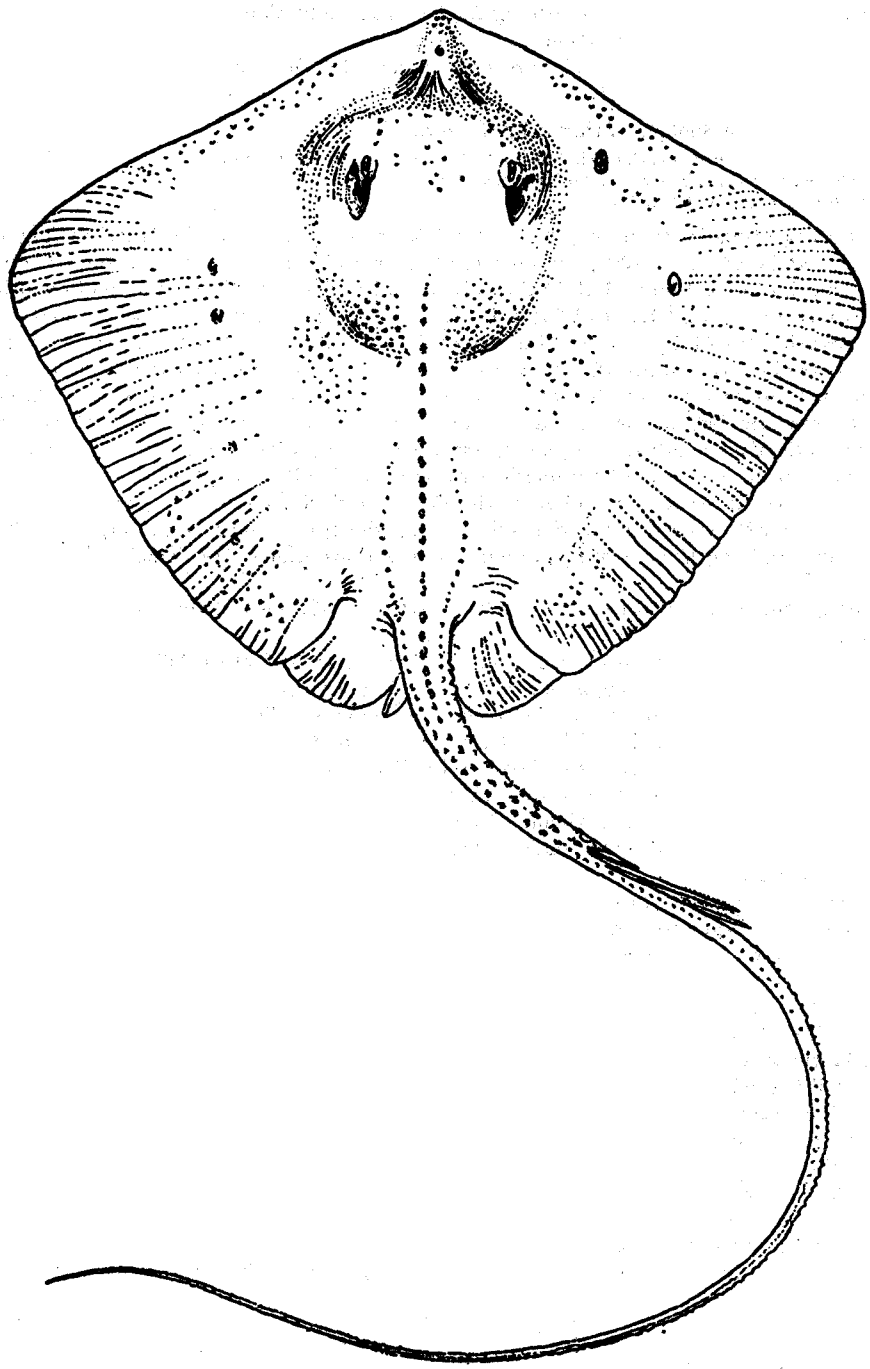

FIG. 36.—*Dasyatis centrura*. (After Garman)

A single (male) specimen with a disk 15 inches in length is present in the Chesapeake Bay collection. Nothing distinctive concerning food and reproduction can be said of this species.

Habitat.—Crisfield, Md., to Brazil.

Chesapeake localities.—(*a*) Previous record: None. (*b*) Specimen in collection: Crisfield, Md., hook and line, September 15, 1921.

20. Dasyatis say (Le Sueur). Sting ray; Stingaree.

Raia say Le Sueur, Journ., Ac. Nat. Sci. Phila., I, 1817, p. 42, with plate; New Jersey.
Dasyatis say, Jordan and Evermann, 1896–1900, p. 86.
Dasybatus say, Garman, 1913, p. 396.

Disk a little broader than long, the anterolateral margins nearly straight, meeting anteriorly in an obtuse angle of about 120°, the posterolateral margins broadly convex, the posterior angles rounded, length of disk 1.06 to 1.13 in its width; head to first gill slit 3.4 to 3.65 in width of disk; distance from snout to vent 1.27 to 1.32; snout 1.4 to 1.77 in head; preoral length of snout 1.6 to 1.75; width of mouth 3.2 to 3.75; interorbital (bone) 2.75 to 3.35; eye, 2.9 to 3.85 in snout; spiracles immediately behind eyes, elliptical, as long as eye; nasorial groove extending to mouth; teeth arranged in pavement, those of the male with an acuminate tip, those of the female smooth; 3 large papillæ at base of lower jaw, behind the teeth and a smaller one on each side back of the outer angle of the teeth; skin perfectly smooth in the young, large individuals with a row of short, blunt spines on median line of back, and sometimes one or two on each shoulder, the tail with spinules; tail long, slender, depressed anteriorly, round and whiplike posteriorly, bearing one or two long, sharply serrated spines, with a short cutaneous fold behind the spine above and a larger one below; tail 1.65 to 1.8 in total length; ventral fins broadly rounded posteriorly, not reaching far beyond end of disk.

Color grayish to brownish above, white below; the distal part of tail and the cutaneous folds on it black.

Eight male specimens with disks ranging in width from 230 to 290 millimeters (9 to 11.5 inches) are at hand and form the basis for the foregoing description.

The stomachs examined were void of recognizable foods. The teeth evidently are constructed for crushing hard objects, and Smith (1907, p. 45) says of this species, "It feeds largely on shellfish." Fish probably form a very small part of its diet. It is worthy of mention in this connection that although the individuals at hand were taken from a pound net, in which fish were easily available, they had not recently fed on them. No determination has been made as to whether or not a difference in the foods sought by the male and female (as suggested by the difference in the structure of the teeth) exists.

The sting ray appears to be common in the southern parts of Chesapeake Bay and at times even abundant. "Numerous and troublesome." (Moseley, 1877, p. 9.) In 1921 this ray was taken in large numbers in pound nets in Lynnhaven Roads, Va., during the latter part of September and early in October, as many as 40 individuals having been seen in one net at one time. The rays at this time probably were on their southward migration from the feeding grounds in the upper stretches of the bay. A southward migration of this species has been noted by observers elsewhere on the Atlantic coast.

The tail is used as a whip, and with the serrated spine the ray sometimes inflicts very painful wounds in the hands and feet of fishermen, who are generally of the opinion that a venom is injected with the spine. The difficulty experienced in healing such a wound, however, undoubtedly is due to septic infection.

Habitat.—New York to Brazil.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimens in collections: Lynnhaven Roads, Va., pound nets, June 9, 1916, and September 26, 1921. Also seined at Cape Charles, Va., May 21, 1922, and observed numerous times in pound nets situated between Ocean View and Cape Henry.

21. Dasyatis sabina (Le Sueur). Sting ray.

Trygon sabina Le Sueur, Journ., Ac. Nat. Sci., Phila., IV, 1824, p. 109, Pl. IV.
Dasyatis sabina Jordan and Evermann, 1896-1900, p. 84, Pl. XIV, figs. 36 and 36a.
Dasybatus sabinus Garman, 1913, p. 397.

Disk little, if any, broader than long, the anterolateral margins distinctly concave in front of eye, meeting at an angle of about 90°, the posterolateral margins broadly and evenly convex, the outer angles of disk very broadly convex, the posterior angle much more sharply rounded, the length of disk 1 to 1.05 in its width; head to first gill slit 2.65 to 2.75 in width of disk; distance from tip of snout to vent 1.15 to 1.2; snout rather pointed, its length 1.4 to 1.5 in head; preoral length of snout 1.5 to 1.6; width of mouth 3.45 to 3.95; interorbital (bone) 3.8 to 4.3; eye 4 to 4.35 in snout; spiracles immediately behind the eyes elliptical, the longest diameter equal to length of eye; nasoral groove extending to mouth; teeth arranged in pavement, similar in both jaws and in the sexes; three large papillæ at base of lower jaw and two small ones at each side; skin almost perfectly smooth in our youngest examples with only a few spines on median line of back, the largest individual with a row of prominent, compressed spines on median line of back, extending from the occiput nearly to base of caudal spine, and two similar spines on each shoulder; the tail long and slender, depressed anteriorly, round and whiplike posteriorly, bearing one or two long, sharply-serrated spines; rather short cutaneous folds behind the spine, both above and below the tail, the lower fold a little broader than the upper; tail 1.6 to 1.65 in total length; ventral fins extending well beyond the disk, their posterior margins rounded, the outer angles sharper than the inner ones.

Color brownish on back, the winglike expansions paler; white underneath. The upper fin fold on the tail yellowish brown, the lower buff.

This ray is represented by four specimens—three males, respectively, 190, 215, and 275 millimeters (7½, 8½, and 10¾ inches) broad, and one female 185 millimeters (7¼ inches) broad. We also have the tail and the teeth of another specimen which measured 16 inches in width, evidently belonging to this species. This ray is rather closely related to *D. say*, from which it may be distinguished by the more pointed snout, the deeper concavity opposite the eyes, in the outline of the disk, and by the paler color of the fin folds on the tail.

The stomachs of the specimens at hand all contained fragments of crustaceans.

This sting ray apparently reaches a moderate size. The specimens previously mentioned, measuring 16 inches in width, appears to be among the largest taken to date. The species, although previously not recorded from Chesapeake Bay, probably is not rare there. It was not recognized in the field as distinct from *D. say*, and the fishermen do not distinguish it. The specimens were seclected at random from various catches, with the result that 5 of this species and 8 of *D. say* were preserved.

Habitat.—Previously recorded from North Carolina to Brazil. The range is now extended to Chesapeake Bay. The species enters fresh water.

Chesapeake localities.—(*a*) Previous records: None. (*b*) Specimens in present collection: Lower York River, Va., collecting seines, July 8 and October 6, 1921, and Ocean View, Va., commercial and collecting seines, October 2, 6, and 16, 1922.

15. Genus PTEROPLATEA Müller and Henle

Disk much broader than long, very strongly depressed, the anterior angle obtuse, the lateral angles acute; tail slender, shorter than body, with or without a serrated spine and without a fin. This skate reaches a rather large size. A single species inhabits the Atlantic coast.

22. Pteroplatea micrura (Schneider). Sand skate; Butterfly ray.

Raia micrura Schneider in Bloch, Syst. Ichth., 1801, p. 360; "Surinamo."
Pteroplatea maclura Bean, 1891, p. 94; Jordan and Evermann, 1896-1900, p. 86.
Pteroplatea micrura Garman, 1913, p. 414, pl. 23, figs. 3 and 4.

Disk much broader than long, anterolateral margins convex opposite the head, the median portion of the margins broadly concave, the outer angles rounded, the posterolateral margins broadly convex, length of disk 1.65 to 1.85 in the width; head to first gill slit 5.6 to 6.8 in width of disk; distance from snout to vent 1.95 to 2.1; snout at its tip projecting very slightly beyond the outline of the disk, its length 1.5 to 1.8 in head; preoral length of snout 1.37 to 1.62; width of

mouth 1.67 to 2.05; interorbital (bone) 2.1 to 2.45; eye 3.6 to 5 in snout; spiracle in a quadrangular pit immediately back of eye, no tentacle on its posterior margin, the slit equal to diameter of eye; teeth in numerous rows, about 75 to 100 in each jaw, arranged in definite series like bricks in a pavement, the teeth slightly spear-shaped, each tooth with a broad base and an elongate, sharp cusp; skin entirely smooth in specimens at hand, large individuals are reported to bear caudal spines; tail very short, pointed, with a keel above and below, its length 4.07 to 4.95 in total length; ventral fins rather narrow, inserted notably in advance of the posterior margin of the disk, the posterior margins rounded; claspers of the male long and narrow, reaching half their length beyond posterior margin of ventrals in specimens 14½ inches broad.

Color variable, gray, brown, light green, or purple above, with vermiculations and punctulations of lighter and darker colors; the tail lighter than body, with three or four dark bars; the anterolateral margins of disk frequently with roundish spots; lower parts plain white, outer margin of wings sometimes grayish, dusky, or salmon.

The foregoing description is based on six specimens—four males and two females—ranging in length from 175 to 270 millimeters (7 to 10¾ inches) and in width from 265 to 375 millimeters (10½ to 14¾ inches), and the jaws with the teeth of a female, which, according to field measurements, was approximately 595 millimeters (23½ inches) long and 860 millimeters (34 inches) broad. This skate is characterized by the very broad body, the short tail, and by the absence of a tentacle behind the spiracle, or breathing hole, situated just behind the eye.

This skate is taken in Chesapeake Bay from May until November. In September and early in October of 1921 numerous specimens were taken in pound nets in Lynnhaven Roads, where the latest catch was made on November 28. As many as 40 individuals were frequently caught by one net during a 24-hour period. It is probable that this skate migrates southward at this season of the year, returning from the more northerly feeding grounds in the bay. Most of the individuals taken in pound nets were of small size, specimens ranging from 10 to 13 inches in width predominating. At Ocean View, Va., however, only three small specimens, 10½ to 10¾ inches in width, were taken in commercial and collecting seines from September 25 to October 27, 1922. This skate and the sting ray (*Dasyatis say*) appear to be about equally common.

Little is known of the food of this species, but it is known to feed on crabs (Sumner, Osborne, and Cole, 1913, p. 739) and no doubt also on other crustaceans. The teeth appear to be too weak to crush oysters and clams. The stomachs examined, taken from specimens caught in a pound net, were empty.

The species is viviparous and the normal number of young produced appears to be two, the greatest width of the young at birth being 6 inches (Smith, 1907, p. 45). The frequent presence of this species on sandy shores has caused it to be named "sand skate," and it is called "butterfly ray" in allusion to the very broad, winglike expansion of the pectoral fins. The "wings" of this species are utilized to a limited extent as crab bait in the crab industry on Chesapeake Bay.

This species is reported to reach a length of 4 feet (Smith, 1907, p. 45), also 15 to 18 feet (Uhler and Lugger, 1876). The largest individual mentioned in the field notes of the collectors of the present collection is the specimen previously mentioned measuring 23½ inches in length.

Habitat.—Cape Cod to Brazil.

Chesapeake localities.—(*a*) Previous records: Cape Charles; "vicinity of Norfolk, Va." (Moseley, 1877, p. 9.) (*b*) Specimens in collection or observed in the field were taken at Back River, Ocean View, Lynnhaven Roads, and Cape Charles, Va., during May, June, September, October, and November.

Family XIII.—MYLIOBATIDÆ. The eagle rays

Disk broad; pectoral fins not continued to the end of the snout, but ceasing at side of head; a pair of rostral fins joined in front of head, supported by fin rays; tail long and slender, bearing a dorsal fin and usually a strong serrated spine on its basal portion; eyes large, lateral; spiracles large, behind eyes; teeth broad, flat, tessellated, the median ones usually broader than the others.

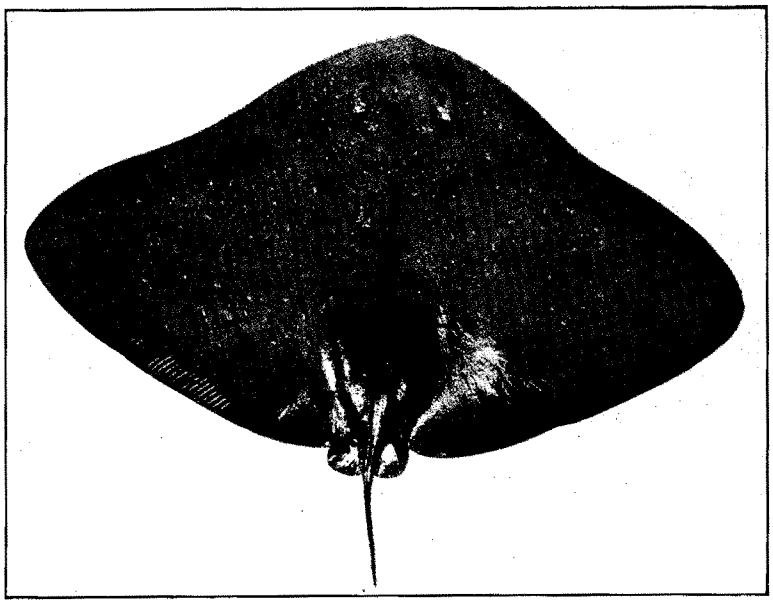

FIG. 37.—*Pteroplatea micrura.* An adult female, 504 millimeters long

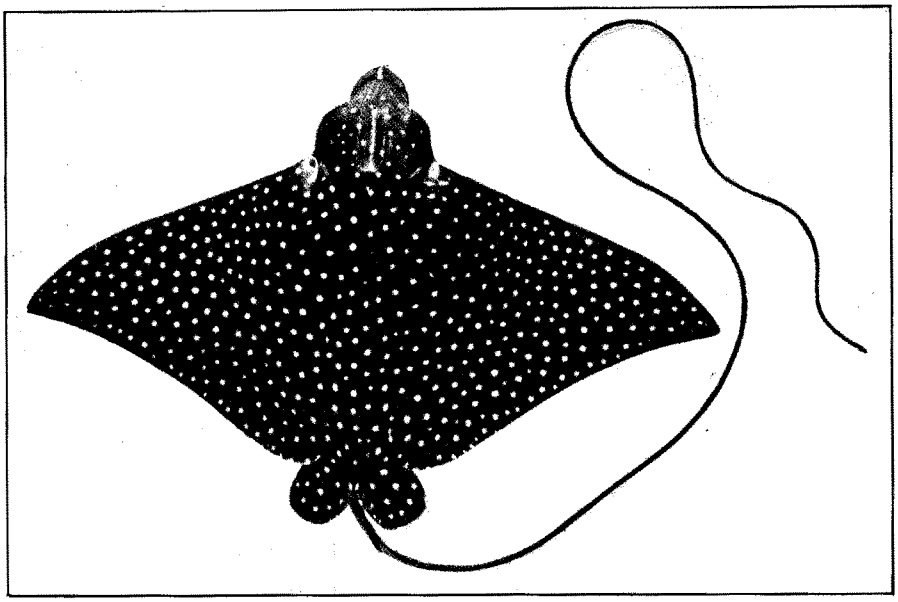

FIG. 38.—*Aëtobatus narinari.* Showing coloration of young

KEY TO THE GENERA

a. Teeth in the jaws in several series; sides of head not entirely free from the pectorals; the rostral process and the pectoral fins narrowly confluent ..... Myliobatis, p. 69

b. Teeth in one row in each jaw; pectoral fins not extending along the sides of the head; the rostral fins entirely distinct from the pectorals ..... Aëtobatus, p. 69

16. Genus MYLIOBATIS Cuvier. Eagle rays

Disk broad, the outer angles acute; rostral process narrowly confluent with the pectorals along the sides of the head; teeth in the jaws in 7 to 10 rows, tessellated, the median ones broader than the lateral ones; tail long, slender, bearing on its basal portion a dorsal fin and one or more serrated spines; skin smooth or nearly so.

23. Myliobatis freminvillii Le Sueur. **Eagle ray; Bull-nosed ray; Sharp-nosed ray; Bull ray.**

Myliobatis freminvillii Le Sueur, Jour., Ac. Nat. Sci., Phila., IV, 1824, p. 111; Rhode Island. Uhler and Lugger, 1876, ed. I, p. 185; ed. II, p. 157.

Myliobatis freminvillei Jordan and Evermann, 1896–1900, p. 89.

Disk broader than long, the outer angles rather sharp, anterolateral margin slightly convex, the posterolateral margin broadly concave, length of disk 1.5 in its width; pectoral fins narrowly confluent below eyes with the rostral process, the latter broadly rounded with a slightly protruding median tip; head to first gill slit 4.85 to 5.1 in width of disk; distance from snout to vent 1.8 to 1.95; snout 2.1 to 2.35 in head; preoral length of snout 1.85; width of mouth 2.5 to 2.65; interorbital space 1.9; eye lateral, 1.95 in snout; spiracles quite as large as eyes and situated immediately behind them; nasorial groove extending to mouth; teeth in pavement about 9 transverse rows in upper jaw, 4 functioning, 10 transverse rows in lower jaw, 6 functioning; skin smooth; a prominent, serrated spine present behind dorsal; tail long, whiplike, 1.45 to 1.55 in total length; dorsal fin situated on tail, its origin at vertical from tips of ventrals; ventral fins rather broad, posteriorly convex, its base 1.75 in snout.

Color grayish above, white underneath, the outer tips of the disk becoming dusky. Sometimes reddish or reddish brown above, according to published accounts.

Two specimens—a male and female—355 and 368 millimeters (14 and 14½ inches) wide from tip to tip of disks, are at hand. The broad, pavementlike teeth obviously are constructed for crushing hard objects. The stomachs examined were empty, but, as suggested by the structure of the teeth, we learn from literature that the animal feeds on mollusks and various hard-shelled crustaceans (Sumner, Osborne, and Cole, 1913, p. 739).

This ray is not common. It is little known by the fishermen, who report that it is taken only occasionally in pound nets in the southern parts of Chesapeake Bay. In September and October, 1922, during five weeks collecting at Ocean View, Va., where numerous hauls were made with collecting seines and where 32 hauls of an 1,800-foot commercial seine were observed, only eight individuals were seen. The maximum width of the largest specimen observed was 34 inches and the total length was 5 feet. This appears to be about the maximum size attained by the species.

Habitat.—Cape Cod to Brazil.

Chesapeake localities.—(*a*) Previous record: "Chesapeake Bay" (Uhler and Lugger). (*b*) Specimens in collection: Lynnhaven Roads, Va., pound net, July 17, 1916, and June 25, 1921; also observed at Ocean View, Va., in the fall of 1922.

17. Genus AËTOBATUS Blainville. Spotted eagle rays

Disk broad, the outer angles acute; head prominent; snout narrower than head, produced; rostral fins separate from the pectorals and at a lower level on the sides of the head; teeth in a single row in each jaw, fused, the lower plate long; anterior nasal valves confluent; a median notch in the preoral flap; tail long, slender, bearing a dorsal fin and one or more serrated spines on its basal portion; skin smooth.

24. Aëtobatus narinari (Euphrasen). "Bishop ray"; Spotted eagle ray.

Raia narinari Euphrasen, Handl., K. Vetensk. Akad., XI, 1790, p. 217, Pl. X; Brazil.
Æëtobatis narinari Uhler and Lugger, 1876, ed. I, p. 184; ed. II, p. 156.
Aëtobatus narinari Jordan and Evermann, 1896–1900, p. 88, Pls. XV and XVI, figs. 37 and 38; Garman, 1913, p. 441, pl. 49, figs. 1 to 3 (teeth); pl. 54, fig. 4 (pelvis); pl. 55, fig. 9 (vertebræ); pl. 57, fig. 4 (heart); pl. 73, fig. 4 (skeleton).

"Width of the disk nearly twice the length; anterior borders convex, posterior concave. Pectorals somewhat falciform, acute on the outer angle. Rostral fins distinct from the pectorals, joined in a single, produced, depressed, and pointed lobe. Cranium large, narrower toward the mouth, convex across the crown. Teeth in a single row on each jaw, broad and short, fused, upper wider; lower pavement flatter and more produced. Each tooth is curved or angled forward more or less in the middle, the amount varying in the individuals. Eyes prominent. Spiracles large, lateral, behind the eyes, partly visible from above. Ventrals narrow, elongate, nearly half extended behind the ends of the pectorals, rounded posteriorly. Dorsal small, rounded above, with a short, free margin and an angle behind the base, origin above the ends of the bases of the ventrals. Tail whiplike, very slender, more than four times the length of the body. In a specimen at hand the measurements are from snout to vent 13, from vent to end of tail 59, and across the pectorals 25 inches." (Garman, 1913.)

Color dark brown or black above, white underneath. The dorsal surface with white spots, which are somewhat variable in number, size, and shape, and usually are smaller anteriorly than posteriorly. Anteriorly the spots are round, but posteriorly they sometimes become elongate, ring-shaped, or they appear as incomplete rings, and occasionally two spots become more or less connected by a narrow isthmus. Tail plain black.

This ray was not taken in Chesapeake Bay during the present investigation. The color description offered herewith is largely from notes made by us from specimens examined at Beaufort, N. C. The species is readily recognized by the shovel-shaped snout, the broad disk, which is covered above with numerous white spots, and by the very broad, flat, platelike teeth.

The spotted eagle ray, according to several recent writers, subsists almost wholly upon clams, which it probably digs up with its shovellike snout. The large, flat, platelike teeth and strong muscular jaws are well adapted to crushing hard-shelled mollusks.

This ray has the habit of jumping high above the water and, according to Coles (1910, p. 340) and Gudger (1914, p. 301), it is during this leaping that the young are born. According to Coles, about four young are delivered at one time. The young, when born, are from 6 to 8 inches broad, and they are delivered rolled up lengthwise. The spotted eagle ray reaches a length of about 12 feet and a width of about 7½ feet.

This ray, if it occurs at all in Chesapeake Bay, is very rare, as it was not seen during the present investigation and no information concerning its occurrence could be obtained from the fishermen. It is here included because of the record by Uhler and Lugger (1876).

Habitat.—"Tropical parts of the Atlantic and Eastern Pacific" (Garman); ranging northward on our Atlantic coast to Virginia.

Chesapeake localities.—(*a*) Previous record: "Enters Chesapeake Bay from the ocean and is caught in seines near Norfolk, Va." (Uhler and Lugger, 1876.) (*b*) Specimens in collection: None.

Family XIV.—RHINOPTERIDÆ. The cow-nosed rays

Body, head, and pectorals united to form a broad disk; a pair of rostral fins present, not joined in front of the skull and not continuous at the sides with the pectoral fins; eyes prominent, lateral; spiracles large, behind the eyes, opening laterally; one dorsal fin present, situated on the base of the slender tail and just in front of one or more strongly serrated spines.

18. Genus RHINOPTERA Cuvier. Cow-nosed rays

Disk broader than long, but not as broad as in related genera; tail long, slender; head prominent; rostral fins detached from the pectorals, forming a free and detached lobe in front of each orbit but not produced in front of the middle of the head; dorsal fin present, followed immediately by one or more serrated spines. A single species is known from the Atlantic coast of the United States.

25. Rhinoptera quadriloba (Le Sueur). Cow-nosed ray; Whipparee.

Raia quadriloba Le Sueur, Journ., Ac. Nat. Sci., Phila., I, 1817, p. 44, with plate; New Jersey.
Rhinoptera quadriloba Uhler and Lugger, 1876, ed. I, p. 184; ed. II, p. 156; Bean, 1891, p. 94; Garman, 1913, p. 444, pl. 37 figs. 1 to 5.
Rhinoptera bonasus Jordan and Evermann, 1896–1900, p. 90.

Disk about one-third broader than long; the tail very slender, less than twice as long as the disk; head short, as broad as long; snout deeply indented anteriorly between the rostral fins; teeth in pavement, mostly hexagonal, in seven to nine rows, the median row in each jaw the widest, the functioning teeth deeply pitted; skin smooth; one or two serrated spines immediately behind the dorsal fin; origin of dorsal a little behind the end of the ventral bases, the fin small, its lower angle sharp; caudal fin wanting; ventral fins more than half as wide as long, the posterior margins convex; pectoral fins longer than broad, the outer angles acute, the anterior margins nearly straight, the posterior margins broadly convex.

Color brownish above, pale underneath, with more or less brownish toward the outer angles of pectoral.

This ray was not seen during the present investigations, and although previously recorded from Chesapeake Bay it is evidently very rare. The foregoing description is based upon published accounts of the species. This ray is readily recognized by the broad, emarginate snout, the lateral eyes, and whiplike tail.

The following information concerning the species is submitted by Smith (1907, p. 47): "The species reaches a large size, some examples observed in Florida being 7 feet wide. It feeds largely on mollusks, which it crushes with its powerful paired jaws; the razor clam and the oyster are favorite foods. The young, numbering two or three, are born in spring and summer and are very active from birth. The stout, barbed spine is usually covered with mucus, and the wounds which it inflicts are painful and often dangerous."

Habitat.—Nantucket, Mass., to Florida.

Chesapeake localities.—(*a*) Previous records: "Near the mouth of Chesapeake Bay" (Uhler and Lugger, 1876) and Cape Charles City, Va. (*b*) Specimens in the present collection: None.

Family XV.—MOBULIDÆ. The sea devils

Head, body, and pectorals forming a subrhomboid disk, broader than long; head broad and flat, bearing cephalic fins or processes, developed as two long hornlike appendages, separate from the pectorals; mouth large, transverse, terminal or inferior; teeth small, numerous, in pavement; tail long, whiplike, with a single dorsal fin at its base and with or without a serrated spine; eyes lateral; skin more or less rough; ventrals small, between the pectorals.

Some of the members of this family reach an enormous size. It is said that individuals have been taken which were 20 feet wide and weighed more than 4 tons.

19. Genus MANTA Bancroft. The devilfish

Disk broader than long, its exterior angles acute, the posterior margins concave; head broad, flat, truncate; cephalic processes long, turned forward and inward; mouth very wide, terminal; teeth on lower jaw only, very small, in numerous rows; skin rough, with small tubercles; tail long, whiplike; a small dorsal fin over the ventrals.

26. Manta birostris (Walbaum). Devilfish.

Raia birostris, Walbaum, Artedi Piscium, 1792, p. 535.
Ceratoptera vampyrus Uhler and Lugger, 1876, ed. I, p. 185; ed. II, p. 157.
Manta birostris Jordan and Evermann, 1896–1900, p. 92, Pl. XVIII, fig. 39; Garman, 1913, p. 453.

"Disk nearly twice as wide as long; tail as long as the body, including the rostral fins. Pectorals falciform, acute angles, anterior margin convex, posterior concave. Teeth minute, rasplike, on the lower jaw only, occupying the entire width of the jaw, in about 100 rows separated by interspaces (in the young). Base of the dorsal extending forward a little in front of the ends of the bases of the pectorals and backward to about the middle of the free inner margin of the same fins. Ventrals small, hind margins rounded, not reaching to the ends of the pectorals. Body and tail rough. * * * Back brown, darkening with age; white underneath." (Garman, 1913.)

The devilfish was not taken during the present investigation. This species and a related species (*Mobula hypostomus*), not as yet recorded from Chesapeake Bay, may be recognized at once by two hornlike appendages in front of the head, known as the cephalic or rostral fins. The present species differs from its relative in the entire absence of teeth on the upper jaw.

The devilfish, according to Gill (1910, p. 167), feeds chiefly on small crustaceans and young or small fish. This species, like the spotted eagle ray, also has the habit of leaping above the surface of the water, but it is not definitely known whether this habit is correlated with the delivery of the young, as reported by Coles (1910, p. 340) and Gudger (1914, p. 301) in the case of the spotted eagle ray. The devilfish has only one young at a time, according to Gill (1910, p. 172) and others.

No information concerning the occurrence of this species in Chesapeake Bay was obtained during the present investigation. It was unknown to the fishermen who were questioned. The species is included in this work because of the statement by Uhler and Lugger (1876)—namely, that it is occasionally seen near the entrance to Chesapeake Bay.

Habitat.—Warm waters of both coasts of America. On the eastern coast its range extends northward to Block Island, R. I.

Chesapeake localities.—(*a*) Previous record: "* * * near the entrance to Chesapeake Bay" (Uhler and Lugger, 1876). (*b*) Specimens in the present collections: None.

Class PISCES. True fishes

Superorder GANOIDEI

Order GLANIOSTOMI

Family XVI.—ACIPENSERIDÆ. The sturgeons

Body elongate, cylindrical; skeleton cartilaginous; body imperfectly covered with bony plates or shields; head with similar large plates; snout produced with four flexible barbles hanging from its lower surface; mouth underneath head, small, protractile, suckerlike; teeth wanting; eyes small; tail heterocercal; air bladder large. A single genus of these large fishes is known from Chesapeake Bay

20. Genus ACIPENSER Linnæus. The sturgeons

Bony plates not confluent, one series on back and a lateral and abdominal series on each side; ventral plates often deciduous; snout more or less conical, depressed; spiracles over eye; gill rakers small, pointed.

KEY TO THE SPECIES

a. Space between dorsal and lateral shields with stellate plates of rather large size, in 5 to 10 series; top of head with a smooth area in young and deeply concave; snout long, acute, rather narrow at base; D. 30 to 44; A. 23 to 30 ..... *oxyrhynchus*, p. 72

aa. Space between dorsal and lateral shields with minute spinules, in very many series; top of head without a smooth area in young and less deeply concave; snout short, proportionately broader at base; D. 33; A. 19 to 22 ..... *brevirostrum*, p. 76

27. Acipenser oxyrhynchus Mitchill. "Sturgeon"; Sharp-nosed sturgeon.

Acipenser oxyrhynchus Mitchill, Trans., Lit. and Philo. Soc., N. Y., I, 1815, p. 462; New York. Uhler and Lugger, 1876, ed. I, p. 183, ed. II, p. 155; Bean, 1883, p. 367.

Acipenser sturio Jordan and Evermann, 1896–1900, p. 105, Pl. XX, fig. 45; Smith and Bean, 1899, p. 181; Fowler, 1912, p. 51.

The sturgeon is a fish of variable characters. The following description has been compiled from published accounts, both of American and of European fish, and from an examination of specimens made by us.

Head 3.7 to 5; depth 7 to 10; D. 30 to 44; A. 23 to 30. Most authors give the dorsal rays between 30 and 40, but Ryder (1890, p. 235), who made an extensive study of the sturgeons of the Delaware River, counted 40 to 44 on the fish examined by him. The number of anal rays given by most authors is 23 to 27, but Ryder (loc. cit.) found 26 to 30. The body is elongate, somewhat hexagonal, tapering gradually to base of caudal; head flattened above; snout 2 to 3 in head, vari-

able, pointed in young up to 3 or 4 feet but becoming blunt with age. Smitt (1892, p. 1058) states that the shortening of the snout in relation to length of fish during its growth is accomplished at the expense of its anterior part (the rostral cartilage), the distance from the anterior nostril to the tip of the snout being reduced with age from 47 to 28 per cent of the length of head. Ryder (1890, p. 235), too, is of the opinion that the snout of the common sturgeon undergoes actual shortening and loss of substance during growth. Eye small, elongate, about 5 to 7 in snout; interorbital about 2.7 to 3.2, somewhat concave; mouth underneath head small, protractile, suckerlike; premaxillaries passing around front of mouth; maxillaries small, lateral, articulated with premaxillaries and with palatines; two pairs of short, slender barbels placed in transverse line about midway between end of snout and anterior edge of mouth, never touching mouth when deflected; nostrils double, close together, in front of eye, the posterior pair larger than anterior; teeth wanting, except in young; gill rakers small, sparse; skin smooth, grandular, or covered with small osseous points; dorsal shields 10 to 16 (usually 10 or 11); lateral shields 25 to 36 (usually 26 to 29); ventral shields 8 to 14 (usually 9 to 11); preanal shields present; dorsal far back; caudal heterocercal, the upper lobe longest; anal beginning under posterior half of dorsal; ventrals inserted on a perpendicular beginning a little in front of dorsal; pectorals inserted low, near level of lower edge of gill cover.

Color olive green, bluish gray, or brownish above; pale below.

Two specimens, 7 and 9 feet long, were examined in the Museum of Comparative Zoology, Cambridge, Mass., which gave the following shield counts: Dorsal 10 and 11, lateral 25, ventral 9 and 11. American sturgeons are said to have fewer lateral plates (25 to 29) than the European fish, which usually have from 29 to 36.

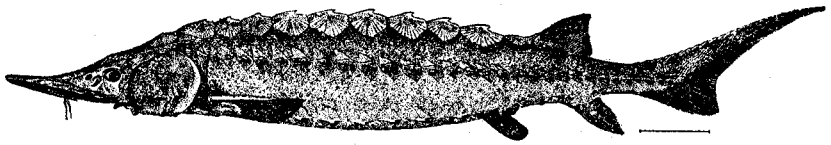

FIG. 39.—*Acipenser oxyrhynchus*

The sturgeon feeds on the bottom, its food consisting of a large variety of animals and plants, perhaps chiefly mollusks, worms, and small fish. When ascending rivers to spawn the sturgeon feeds little or not at all.

Adult sturgeons, according to Smith (1907, p. 56), do not appear in the sounds and rivers of North Carolina until the latter part of April, when the main run of shad is over. Ryder (1890, p. 266) says: "As the season advances the spawning schools move upward from the salt waters of Delaware Bay and in the neighborhood of Fort Delaware and Delaware City, 45 miles south of Philadelphia, where they pass into brackish or nearly fresh water. From this point, southward 20 miles and northward as many more, it is probable that a large part of the spawning occurs." Records of catches of pound nets set in Lynnhaven Roads indicate that the sturgeon usually enters Chesapeake Bay during April. It later enters the rivers where the spawn is deposited. The eggs, when laid, are about 2.6 millimeters in diameter. They are demersal and adhesive, becoming attached to brush, weeds, stones, etc. The eggs hatch in about 1 week in water having a temperature of 64° F. The mature ovaries of the female, according to Smith (1907, p. 56), may constitute one-fourth of the total weight of the fish, and a total of 1,000,000 to 2,500,000 eggs may be produced by one female. The young fish, according to Ryder (1890, p. 267), are sometimes taken from under ice in the Delaware River in midwinter, indicating that they remain in fresh water the whole year.

The newly hatched fry is about 11 millimeters (⅜ inch) in length (Ryder, 1890, p. 268), and in a few days, when the yolk sac is absorbed, it reaches ¾ inch. The later growth has not been followed, but in Europe this sturgeon is said to reach a length of 4 to 5½ inches in two months. Sexual maturity is believed to occur when a length of about 4 feet has been attained.

Small, unmarketable sturgeon, less than 4 feet in length, are even yet taken in sufficient numbers in the Chesapeake to give promise that the present-day small catch of adults will at least hold its own, providing the fishermen in every instance return the immature fish to the water uninjured. From early March until April 8, 1922, in a set of three pound nets off Ocean View, Va., from 3 to

10 small sturgeons were taken each week; while in a set of two nets in Lynnhaven Roads during the same period the weekly catch was 3 to 6, the usual size being from 30 to 40 inches in length. Even in Lower New York Bay, where the adult sturgeon is almost extinct, we have reason to believe that young fish are present in small to fair numbers at the present time. We observed a sturgeon 575 millimeters in length (about 22½ inches) caught on December 21, 1923, off South Beach, New York, by being snagged in the side with a fish hook. A year later the same angler reported another small sturgeon caught in the same manner.

During 1920 the Chesapeake Bay catch of sturgeon amounted to 22,888 pounds, worth $5,353. In addition there was obtained 2,654 pounds of caviar, worth $7,618. The total value of the catch, therefore, was $12,971. In Maryland the sturgeon ranked nineteenth in quantity and sixteenth in value. The catch consisted of 714 pounds of fish, worth $172, and 20 pounds of caviar, worth $87. In Virginia it ranked eighteenth in quantity and tenth in value. The catch consisted of 22,183 pounds of fish, worth $5,181, and 2,625 pounds of caviar, worth $7,531. Of this amount, 90 per cent was caught in pound nets and 10 per cent in gill nets. According to the value of the fish and caviar, the leading counties were Norfolk, $3,518; Elizabeth City, $2,850; Mathews, $1,351; James City, $1,271; and Gloucester, $1,068.

At one time the sturgeon was caught in large numbers throughout Chesapeake Bay, but it has become scarce, and now it is seldom taken north of the mouth of the Potomac River. Fishing is done so intensively that very few are able to reach the headwaters of the bay.

A great decrease in the sturgeon catch occurred after the year 1897, followed by a further decline after 1904 (see table), since when it has never been taken in anything like its former abundance. In May, 1915, at Buck Roe Beach, Va., Radcliffe (field notes) stated: "Very few adults have been taken and few young observed. I saw fish caught on Buck Roe Beach 9 feet long, estimated weight 275 pounds, estimated weight of roe (prepared for shipment) 90 pounds. The owner had difficulty in marketing the fish. Roe worth 50 to 60 cents a pound." Inquiries around the bay during 1921 and 1922 elicited the fact that sturgeons were scarce everywhere and had been for many years. During April and May, 1921, there appeared to be a slight increase in the lower bay pound-net catch as compared with the previous few years. During April, in a set of five pound nets off Buck Roe Beach, six sturgeons of marketable size were caught. On May 16 a 225-pound fish was taken in Lynnhaven Roads. The roe of this fish, after being rubbed and salted, weighed 41 pounds and sold for $3.50 a pound. Other scattering fish were caught, of which we obtained no record. During 1922, in a set of three pound nets at Ocean View that fished from early March to April 8, one large female and two males (the latter weighing 90 and 100 pounds, respectively) were caught. The aggregate catch of these nets up to May 26 was 20 sturgeons over 4 feet in length, 13 of them males and 7 females. The largest amount of spawn from one of the females weighed 59 pounds. In a set of two pound nets operated in Lynnhaven Roads during the same period no adults were caught. The first marketable sturgeon taken in the last-mentioned nets in 1922 was a 40-pound male caught on May 25. At Buck Roe Beach only three sturgeons were reported in 1922 up to April 11. At Lewisetta, Va., on April 22, 1922, the fishermen reported that: "The sturgeon have been scarce this year but are occasionally taken." At Solomons, Md., on April 26, it was said: "A few sturgeon have been taken in this vicinity this spring; one large one was caught April 24." At Love Point, Md., no sturgeons were reported caught during the year 1921. At Havre de Grace, on May 9, the report was: "None caught this year nor for the past three years. At the end of May a few are sometimes taken."

Most of the sturgeons caught in the lower Chesapeake are taken during April and May. During this period large fish are taken, many of them containing eggs suitable for making caviar. Sturgeons are caught during the summer and fall, but usually these fish are rather small (less than 100 pounds) and contain immature roe. Records were obtained from a set of two pound nets located at Lynnhaven Roads, Va., giving the number of sturgeons caught from 1916 to 1922, both inclusive. The aggregate catch, by months, for this period is as follows: April, 9 fish; May, 15 fish; June, 9 fish; July, 4 fish; August, 2 fish; September, 1 fish; October, 9 fish; November, 1 fish.

In comparison with the present-day scarcity of sturgeons, the catches made in the following rivers during 1880 show that at one time this fish was abundant in the Chesapeake drainage: James River, 108,900 pounds; York River and tributaries, 51,661 pounds; Rappahannock River,

17,700 pounds; Potomac River, 288,000 pounds. The following table shows the tremendous decline in the catch and the corresponding increase in value of sturgeons caught in Chesapeake Bay.

The catch of sturgeons taken in Chesapeake Bay during certain years from 1887 to 1920

Year	Maryland				Virginia				Average price per pound received by fishermen	
	Sturgeon		Caviar		Sturgeon		Caviar		Sturgeon	Caviar
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*		
1887	7,800	$296	(?)	----------	(?)	----------	(?)	----------	$0.038	(?)
1888	7,350	312	(?)	----------	(?)	----------	(?)	----------	.042	(?)
1890	99,932	3,313	(?)	----------	814,400	$24,466	(?)	----------	.03	(?)
1891	72,445	2,343	(?)	----------	720,381	21,304	(?)	----------	.03	(?)
1897	141,069	4,788	1,594	$644	584,967	14,475	59,600	$17,717	.026	$0.30
1901	8,415	618	748	444	171,943	11,260	17,858	9,932	.065	.55
1904	8,705	552	913	621	153,865	13,429	19,904	13,977	.086	.70
1920	705	172	29	87	22,183	5,181	2,625	7,531	.23	2.87

It is a matter of common knowledge that at one time sturgeons were considered worthless and large numbers were destroyed annually by fishermen, who regarded them as a pest. Their value gradually became apparent, however, and a special fishery was inaugurated. Being a large, sluggish fish, it was easily captured in great numbers, with the result that each year the aggregate catch became smaller and smaller. The retail price of fresh sturgeon has advanced steadily from about 10 cents a pound during 1900 to 50 cents during 1921 and 1922. Smoked, it is considered a delicacy and is among the highest-priced fishes.

Even more phenomenal was the tremendous increase in the value of sturgeon eggs, from which caviar [4] is prepared. The wholesale price advanced from 30 cents per pound in 1897 to $2.87 in 1920 and $3.50 in 1922.

The sturgeon is mentioned in early American history. The first market for American sturgeon was established when (in 1628) the fish were cured near Brunswick, Me., and shipped to Europe, where they were much esteemed. Large quantities taken in the vicinity of Ipswich, Mass., about 1635, were likewise shipped to Europe. The Rhode Island Indians captured sturgeons with harpoons and prized them highly for food.

The vessels worked their way up the coast until Delaware Bay was reached about April 1, and operations were continued here until early in May. The fish caught in the south were sent to Savannah, where they were skinned, packed in ice, and forwarded to New York. The Delaware Bay and Chesapeake Bay fish were likewise shipped to New York, which seemed to be the only large market for sturgeon. At this time the fishermen received about 6 or 8 cents per pound. During 1880 about 3,000,000 pounds of sturgeon were smoked in New York City and were consumed mainly by the German population.

Preparing caviar from the eggs of the Atlantic sturgeon was attempted as far back as 1849 by a Boston firm operating at Woolwich, Me. Because of an alleged scarcity of fish, operations were discontinued in 1851 and were not revived until 1872. By 1880 sturgeon eggs were utilized at many places along the Atlantic coast, but at that time the fishermen received only about 7 cents per pound. At Cape Fear River, N. C., the eggs were discarded as being valueless.

The present-day method of preparing sturgeon for market is essentially the same as that used during 1880. The fish is bled by cutting off the tail, and later the head, viscera, and skin are removed. The carcass is then iced in a box or a barrel and is ready for shipment. The average weight of an adult sturgeon is about 150 pounds, and when a fish of this size is dressed the carcass weighs about 65 pounds.

At the present time most of the Chesapeake Bay sturgeons are caught incidentally in pound nets, but a few are taken in gill nets. After the fish are dressed they are shipped to Norfolk, Balti-

[4] The process of making caviar is explained in "Caviar: What it is and how to prepare it." U. S. Bureau of Fisheries Economic Circular No. 20, issued Apr. 19, 1916; revised edition, issued Oct. 28, 1925.